REMARKS

Reconsideration of this application in light of the amendments and the following remarks is respectfully requested.

I. Status of the Claims

Claims 1-6, 8-9, 11, and 15-41 are pending in this application, of which claims 22-38 have been withdrawn from consideration. Claims 1-4, 6, 8-9, 15-17, 19, 21, 39, and 41 have been amended and claims 5, 14 and 22-38 have been canceled, without prejudice or disclaimer, by way of this response.

Claims 1-4, 6, 8-9, 15-16, 19, 39, and 41 have all been amended to replace the phrase "one or more polymer molecules" with the term "biomolecule." Support for this amendment is found throughout the specification, in particular at paragraph [0027]. Applicants submit that the deletion of the phrase "one or more" from these claims was made for clarity, and that the term "biomolecule" refers to one or more biomolecules.

Claims 1, 6, 8-9, 17, 19, 21, and 39 have all been amended to replace the phrase "one or more catalyst nanoparticles" with "at least two or more catalyst nanoparticles." Support for this amendment is found throughout the specification, in particular at paragraph [0026] wherein the covalent attachment of catalyst nanoparticles to biomolecules is described in detail.

Claims 1 and 39 have been further amended as follows:

(1) to recite that "the at least two or more catalyst nanoparticles are attached to the biomolecule with a defined spacing, wherein the defined spacing is defined by the spacing between the at least two or more selected locations on the biomolecule." Support for this amendment is found in paragraphs [0024] and [0026] of the specification and in Figure 2;

(2) to recite the additional step of "aligning the biomolecule with a substrate such that the at least two or more catalyst nanoparticles are ordered on the substrate in a non-random fashion." Support for this amendment is found in paragraphs [0041] - [0042], and in paragraph [0075] of the specification;

(3) To recite the term "covalently" before "attaching" in step (c). Support for this amendment is found in paragraph [0035] of the specification; and

(4) to delete the term "catalyst nanoparticles" in step (e) and replace it with the term "carbon nanotubes." Support for this amendment is found in paragraph [0024] of the specification.

All amendments are supported by the application as originally filed. Accordingly, no new matter has been added by way of this Response.

II. Objections to the Specification

The Examiner has objected to the specification because it contains an imbedded hyperlink and/or other browser-executable code in Table 1. In response, applicants have amended Table 1 of the specification to remove all of the hyperlinks and replace them with web addresses in normal text. Thus, the Examiner's objection is believed to have been addressed and overcome.

III. Rejection of claims under 35 U.S.C. § 112, First Paragraph (written description)

Claims 1-6, 8-9, 11, 14-21, and 39-41 have been rejected for allegedly failing to comply with the written description requirement. First, the Examiner asserts, based on the citing of twenty-four alleged admissions in the present specification (*See* Office Action at pages 3-5), that it is unclear whether the applicant possessed any subject matter patently distinct from the prior

art described in the specification. Second, the Examiner contends that, if the claimed invention was actually reduced to practice, applicants would have provided documentation to demonstrate that the methods work in practice (i.e., a "photograph" of the pattern carbon nanotube arrays with fluorescence microscopy and/or atomic force microscopy). The rejection is respectfully traversed.

The written description requirement requires that the specification provide disclosure that allows one of ordinary skill in the art of the invention to "recognize that [the inventor] invented what is claimed." *Lockwood v. American Airlines, Inc.,* 107 F.3d 1565, 1572 (Fed. Cir. 1997); *see also Vas-Cath Inc. v. Mahurkar,* 935 F.2d 1555, 1563-64 (Fed. Cir. 1991) (Applicant "must convey with reasonable clarity to those skilled in the art that ... he or she was in *possession* of the invention.") (emphasis in original). The precise words of the claim need not be present in the application. *Fujikawa v. Wattanasin,* 93 F.3d 1559 (Fed. Cir. 1996) (Disclosure need only "reasonably convey" possession; "ipsis verbis disclosure is not necessary to satisfy the written description requirement of section 112.") Upon reading the specification, one of ordinary skill in the art "must immediately discern the limitation at issue in the claims." *Purdue Pharma L.P. v. Faulding Inc.,* 230 F.3d 1320 (Fed. Cir. 2000).

With regard to the Examiner's first basis for rejection, applicants submit that the specification describes the claimed invention with all of its limitations using the appropriate descriptive means such as words and figures that fully set forth the claimed invention. The fact that a particular step(s) recited in the currently pending method claims may be known in the prior art is irrelevant to the written description inquiry, and would be better suited for application under the standard of obviousness. Indeed, the proper question under 35 U.S.C. § 112, first

paragraph is whether there is sufficient written description to inform the skilled artisan that applicant was in possession of the claimed invention as a whole.

With regard to the Examiner's second basis for rejection, applicants submit that the written description requirement does not mandate that an actual reduction to practice be documented in the specification through, for example, fluorescence or atomic force microscopy. It is true that actual reduction to practice ordinarily provides the best evidence that an invention is complete, however, it certainly does not follow that proof of actual reduction to practice is required in every case ("An applicant need not have actually reduced the invention to practice prior to filing." *See* MPEP 2164.02). In fact, the applicants can show that they were in possession of the claimed invention by "showing that the invention was 'ready for patenting' such as by disclosure of drawings or structural chemical formulas that show that the invention was complete, or by describing distinguishing identifying characteristics sufficient to show that the applicant was in possession of the claimed invention." (*See* MPEP 2163.02; emphasis added).

In support of the present response to the written description rejection, applicants respectfully submit a Declaration under 37 C.F.R. § 1.132 of Dr. Kai Wu, Ph.D. (the "Wu Declaration"). The applicants respectfully invite the Examiner to consider the statements made within the Wu Declaration which demonstrate that the applicants sufficiently described all of the distinguishing characteristics of the claimed invention such that one of ordinary skill in the art would be informed that the applicants were in possession of the claimed invention as a whole.

As stated in the Wu Declaration, one of ordinary skill would view the presently claimed invention as directed to a five step method for producing patterned arrays of carbon nanotubes on a substrate, wherein the distribution of the nanotubes is controlled by the prior attachment of

catalyst nanoparticles on the substrate, and wherein the catalyst nanoparticles are directed to the substrate by way of their attachment to a biomolecule. The patterned arrays on carbon nanotubes are created through aligning the biomolecule with the substrate to deposit the nanoparticles in a non-random fashion, and then producing substrate attached carbon nanotubes on the catalyst nanoparticles.

The written description support for each step of the method of independent claims 1 and 39 are detailed below and supported by the statements made in the Wu Declaration.

Regarding step (a), the specification discloses a number of methods for attaching catalyst nanoparticles to biomolecules such as proteins, nucleic acids and other polymers so that there is a defined spacing between the nanoparticles. Specification at para. [0026], lines 1-4 ("The attachment site for catalyst nanoparticles ... on individual polymer molecules can be determined. For example, streptavidin modification of specific amino acid residues on a protein or peptide can be used to bind biotinylated ferritin to selected sites on the three-dimensional protein or peptide." emphasis added) and para. [0026], lines 5-7 ("Alternatively, streptavidin hybridized oligonucleotide ... probes can be used to hybridize to selected locations on a single stranded DNA molecule ..., followed by binding of biotinylated ferritin." emphasis added).

Regarding step (b), the specification discloses a number of methods for aligning a biomolecule with a substrate to further align the catalyst nanoparticles with the substrate in a non-random fashion. Specification at para. [0042], lines 1-4 ("The method of polymer alignment used is not limiting and any known method, including ... optical tweezers, DC and/or AC electrical fields, microfluidic flow, and/or magnetic fields applied to attached ferromagnetic nanoparticles ... is contemplated.") Specification at para. [0041], lines 1-3. (The attached

nucleic acids ... can be aligned using a number of well known techniques. An exemplary method for aligning nucleic acids ... on a substrate is known a molecular combing.") *See* also, para [0075], lines 1-3 for protein alignment techniques.

Regarding step (c), the specification discloses a number of methods for attaching a biomolecule with a substrate. Specification at para. [0035], lines 1-6, ("In various embodiments, nucleic acid molecules ... can be immobilized by attachment to a solid surface ... [using] a variety of known methods involving either non-covalent or covalent attachment. For example, immobilization can be achieved by coating a solid surface with streptavidin or avidin ... and binding of biotin ... conjugated nucleic acid.") and at para [0075], lines 3-6 ("Proteins ... can be attached to substrates using standard techniques, such as silanization and activation via carbodiimide or glutaraldehyde.").

Regarding step (d), the specification discloses a technique for removing biomolecules from the substrate. Specification at para. [0021], lines 7-8. ("Before nanotube production, the polymer molecules can be removed, for example by heating to about 600 to 800 °C in air or oxygen"). Furthermore, heat treatment (i.e., burning as recited in claim 39) of the attached polymer molecules can be used to convert, e.g., biomolecule-bound iron containing proteins to discrete iron oxide nanoparticles suitable for catalytic growth of single-walled carbon nanotubes (*See* specification at para. [0028], lines 1-10). According to the Wu Declaration, this treatment to remove the biomolecule would result in the deposition of the catalyst nanoparticle on the substrate and, if desired, the carbon nanotubes can be grown directed from the deposited catalyst nanoparticles in the same reaction chamber.

Regarding step (e), the specification discloses a number of techniques for producing substrate attached carbon nanotubes from catalyst nanoparticles that are bound to a substrate. Specification at para. [0022], lines 1-9, ("Methods for carbon nanotube formation using catalyst nanoparticles ... such as ferritin are known. ... Typically, catalyst nanoparticles ... are used in combination with ... CVD techniques ... . The catalyst nanoparticles ... serve as nucleation sites for carbon nanotube growth and formation.") and at para [0024], lines 1-4 ("Such techniques have been used to produce arrays of carbon nanotubes attached to a substrate ... wherein the areas ... in which nanotubes are formed can be controlled by controlling the distribution of catalyst nanoparticles ... on the substrate." Furthermore, the specification teaches that "because the polymer molecules can be attached to the substrate in an ordered pattern before nanotube synthesis, the resulting nanotubes become attached to the substrate in an ordered pattern, determined by the distribution of the catalyst containing polymer ... molecules on the substrate." (*See* para. [0021], lines 3-7).

As stated in the Wu Declaration, based on the aforementioned written description support for each step of the claim 1 and claim 39 methods, a person of ordinary skill in the art would understand that the inventors were in possession of the claimed method as a whole. Accordingly, applicants respectfully submit that the written description rejection of the claims has been traversed. Thus, withdrawal of the present rejection is respectfully requested.

III. Rejection of claims under 35 U.S.C. § 112, First Paragraph (enablement)

Claims 1-6, 8-9, 11, 14-21, and 39-41 have been rejected for failing to comply with the enablement requirement. The Examiner asserts that claims are not enabled based on the breadth of the independent method claims, the absence of working examples in the specification,

direction and guidance primarily in the form of citation to other works, and the amount of experimentation necessary to practice the invention after a review of the specification and the prior art.

The specification enables the full scope of these claims. Each of the steps required to make and use the claimed invention can be carried out using the procedures set forth in the instant specification and routine procedures that were well known to those of ordinary skill in the art as of the filing date of the application. Hence, as of the filing date of the application, it was routine to (1) attach catalyst nanoparticles e.g., proteins containing metal ions such as ferritin, to biomolecules, (2) align biomolecules with a substrate, (3) covalently attach biomolecules to a substrate, (4) remove biomolecules from a substrate while optionally converting the catalyst nanoparticles to metal oxides that attach to a substrate, and (5) grow carbon nanotubes on a substrate using catalyst nanoparticles. The applicants have provided sufficient guidance throughout the specification to show one of ordinary skill how to make and use the invention, including detailed descriptions of the several ways for carrying out each step of the claimed invention and, when appropriate, direction to well known techniques in prior art patents and literature references.

In support of the present response to the enablement rejection, applicants respectfully invite the Examiner to consider the statements made in the Wu Declaration which demonstrate that the specification provides sufficient disclosure to show one of ordinary skill in the art how to make and use the claimed invention without undue experimentation. The written description support for each of the five steps of independent method claims 1 and 39 are detailed below and supported by the statements made in the Wu Declaration.

Regarding step (a), the specification of the '141 application discloses a number of techniques that can be used to attach the nanoparticles to the biomolecules. For example, specification at para. [0026], lines 9-12

> "[P]eptides ... and nucleic acids ... can be chemically synthesized, incorporating modified amino acids ... or modified nucleotides into the growing polymer ... at predetermined locations within the polymer ... sequence. The modified amino acid or nucleotide residues can then be used to attach catalyst nanoparticles ... to specific locations on the polymer."

The specification also teaches a number of alternative techniques that can be used for nanoparticle attachment, such as using amino acid analogues, and modification of specific amino acid residues (e.g., cysteine or lysine) post synthesis. As discussed in the Wu Declaration, these techniques are routine in the art of biochemistry and materials science. Thus, one of ordinary skill would know how to attach catalyst nanoparticles to biomolecules with a defined spacing between the nanoparticles (i.e., attachment only at, e.g., modified amino acids).

As taught in the specification, the modification of biomolecules at, e.g., specific amino acid and/or nucleotide sites, and the attachment of nanoparticles, e.g., protein-based nanoparticles such as biotinylated ferritin to these specific sites was well known in the prior art. Furthermore, the specification provides considerable direction and guidance for how to apply these well known techniques to the presently claimed invention (*See* e.g., specification at paras. [0026]-[0028] and [0074]). Accordingly, the covalent attachment of catalyst nanoparticles to biomolecules with a defined spacing between the nanoparticles would not involve undue experimentation.

Regarding step (b), the specification cites a number of references that describe aligning biomolecules using techniques including optical tweezers, DC and/or AC electrical fields,

microfluidic flow, molecular combing and/or magnetic fields applied to attached ferromagnetic nanoparticles (*See* specification at paras. [0025], [0041]-[0042] and [0075]). As discussed in the Wu Declaration, these techniques are routine in the art of biochemistry and materials science. Furthermore, the specification teaches a new method for aligning nucleic acids comprising attaching, for example, DNA to a molecular wire and aligning the molecular wire with a substrate (*See* para. [0044]-[0048], and Figure 4). Thus, one of ordinary skill would know how to align biomolecules containing bound catalyst nanoparticles with a substrate.

The specification provides considerable guidance for how to align biomolecules for use in the presently claimed methods, and the specification directs one of skill in the art to well known techniques in the literature for particular examples of bimolecular alignment (*See* e.g., specification at para. [0025]). Accordingly, the alignment of biomolecules with a substrate such that the catalyst nanoparticles are aligned with the substrate in a non-random fashion would not involve undue experimentation.

Regarding step (c), the specification cites a number of references that describe several techniques for covalently attaching biomolecules to a substrate, (*See*, e.g., para. [0075]) or describes such attachment with a sufficient description to enable one of skill in the art to covalently attach the biomolecules to a substrate (*See*, e.g., para. [0035] - [0039]). As discussed in the Wu Declaration, these techniques are routine in the art of biochemistry and materials science. Thus, one of ordinary skill would know how to attach biomolecules to a substrate.

The specification provides considerable guidance for how to covalently attach biomolecules to a substrate for use in the presently claimed methods, and the specification directs one of skill in the art to well known techniques in the literature for particular examples of

biomolecule attachment (*See* e.g., specification, e.g., at para. [0075]). Thus, the covalent attachment of biomolecules to a substrate would not involve undue experimentation.

Regarding step (d), the specification cites references that describe how to convert, e.g., iron containing proteins to catalyst nanoparticles suitable for catalytic growth of single-walled carbon nanotubes (*See* specification at para. [0028], lines 1-10), and, as discussed in the Wu Declaration and above, the specification teaches that these techniques can be used both to remove the biopolymer, and to direct these catalyst nanoparticles to the substrate. Biopolymer removal techniques and catalyst nanoparticle synthetic techniques using, e.g., high temperatures are routine in the skill of biochemistry and materials science, and the use of high temperatures to simultaneously remove the biomolecule and deposit the catalyst nanoparticle a substrate is described and enabled in the specification. Thus, one of ordinary skill in the art would know how to remove biomolecules such that the nanoparticles attach to the substrate at a biomolecule directed site.

The specification provides considerable guidance for how to remove biomolecules from a substrate for use in the presently claimed methods. In one example, the methods of biomolecule removal involve no more than decomposing the biomolecule at high temperature, a technique that is clearly routine to one of skill in the art. Accordingly, removing biomolecules such that the nanoparticles attach to the substrate at a biomolecule directed site would not involve undue experimentation.

Regarding step (e), the specification cites a number of references that describe how to grow carbon nanotubes from catalyst nanoparticles bound to a substrate (*See,* e.g., specification at para. [0022] - [0024]). These carbon nanotube growth techniques using, e.g., chemical vapor

deposition are routine in the art of materials science, and their use in conjunction with techniques to deposit catalyst nanoparticles on a substrate at a biomolecule directed site is described and enabled in the specification. As stated in the Wu Declaration, one of ordinary skill would known how to produce substrate attached carbon nanotubes on the catalyst nanoparticles with non-random distribution (i.e., due to the biomolecule directed distribution of the catalyst nanoparticles).

The specification provides considerable guidance for how to synthesize carbon nanotubes from catalyst nanoparticles for use in the presently claimed methods, and the specification directs one of skill in the art to well known techniques in the literature for particular examples of carbon nanotube synthesis (*See* e.g., specification, e.g., at paras. [0022]-[0024]). Thus, the synthesis of substrate attached carbon nanotubes on a catalyst nanoparticle with non-random distribution of the nanotubes on the substrate would not involve undue experimentation.

Based on the above arguments and the statements made in the Wu Declaration, examination of the factors set forth in *In re Wands* (858 F.2d. 731, 8 USPQ2d 1400 (Fed Cir 1988)) leads to the conclusion that the full scope of the instant claims is enabled.

Breadth of the claims. The claims have been restricted to methods of producing substrate bound carbon nanotubes, wherein catalyst nanoparticles are attached to biomolecules which are, in turn, covalently attached to the substrate. Using alignment techniques, the biomolecules are positioned so as to order the nanoparticles on the substrate in a non-random fashion. Removal of the biomolecule allows the nanoparticles to attach to the substrate for subsequent nanotube growth. As discussed above, at the time the application was filed, the techniques for carrying out

each of the five steps of the claimed method were either sufficiently described in the specification or were well known in the art.

Nature of the invention. The nature of the invention relates to the biomolecule-directed deposition of catalyst nanoparticles on a substrate, from which carbon nanotubes are grown.

The level of ordinary skill in the art. As stated in the Wu Declaration, the level of skill in the art is high. All of the techniques needed to practice the claimed invention were in routine use at the time the application was filed.

The level of predictability. The techniques required to practice each step called for in the pending claims are highly predictable based on the large body of literature that was available to one of skill in the art at the time the application was filed. When necessary, the specification provides appropriate citation to this literature. Thus, it is apparent that each step of the claims may be predictably derived using the methods set forth and/or cited to in the application.

Amount of direction or guidance. Applicants have discussed at length *supra* that the specification gives extensive guidance for each step of the pending method claims either through thorough description of the required techniques, or by reference to the prior art. The fact that "old and known techniques" can be used to carry out one or more of the steps is not relevant to this inquiry as long as the specification provides sufficient direction and guidance.

The existence of working examples. It is well-settled that there is no requirement for working examples in a patent specification. *See In re Wright*, 999 F.2d 1557, 1561 (Fed. Cir. 1993) ("Nothing more than objective enablement is required, and therefore it is irrelevant whether [a] teaching is provided through broad terminology or illustrative examples."); *In re*

Robins, 429 F.2d 452, 457 (CCPA 1970) ("representative [examples] are not required by the statute and are not an end in themselves").

As discussed above, techniques for carrying out each step of the present method claims are sufficiently described throughout the specification and were well known to those of skill in the art. These techniques may be used predictably in combination with one another to arrive at the presently claimed methods. The predictability of each sufficiently described step of the claimed methods precludes the Examiner's assertion that the lack of working examples is important.

The quantity of experimentation needed to make or use the invention based on the content of the disclosure.

To be enabling, the specification must teach one of ordinary skill in the art to make and use the full scope of the claimed invention without "undue experimentation." *In re Wright,* 999 F.2d 1557, 1561, 27 U.S.P.Q.2d 1510, 1513 (Fed. Cir. 1993). As long as "undue experimentation" is not involved, a specification complies with the enablement requirement, even if a reasonable amount of routine experimentation is required to practice the invention. *Enzo Biochem Inc. v. Calgene,* 188 F.3d 1362, 1371, 52 U.S.P.Q.2d 1129, 1135 (Fed. Cir. 1999). Even "a considerable amount of experimentation is permissible, if it is merely routine." *In re Wands* 858 F.2d 731, 737, 8 U.S.P.Q.2d 1400, 1404 (Fed. Cir. 1988).

The predictability with which each step of the pending method claims can be performed indicates that only routine experimentation is required to make and use the claimed invention. Moreover, as stated in the Wu Declaration, the techniques required to practice each of the steps of the claimed invention were well known and predictable at the time the invention was made.

Thus, one of skill in the art would know how to make and use the invention without undue experimentation.

For the reasons set forth above, Applicants respectfully submit the rejection of the claims under 35 U.S.C. § 112, first paragraph for lack of enablement has been addressed and overcome. Reconsideration of the claims and withdrawal of the rejection thereof for lack of enablement under 35 U.S.C. §112, first paragraph is respectfully requested.

Rejection of claims under 35 U.S.C. § 102

Claims 1, 5, 6, 8, 14, 18, 20, 21, 39, and 40 have been rejected as allegedly anticipated by Dai et al. (U.S. 6,401,526). The Examiner has maintained the substance of the rejection originally asserted in the Office Action of June 8, 2006. Specifically, the Examiner contends that Dai discloses a "precursor mixture" containing inorganic chlorides, a long chain molecular polymer, and a solvent, wherein the precursor mixture is deposited on a alumina/silica matrix and calcined in air to deposit, e.g., iron-oxide suitable for the growth of carbon nanotubes. The Examiner further asserts that the catalyst is attached to the substrate in a non-random fashion because it is deposited on a plurality of substrate attached conical silicon tips. The rejection is respectfully traversed.

In response, without conceding the validity of the Examiners rejection, the applicants have amended independent claims 1 and 39 to, *inter alia*, require that (1) at least two nanoparticles are attached to a biomolecule at selected locations such that there is a defined spacing between the at least two nanoparticles, wherein the defined spacing is defined by the spacing between the at least two or more selected locations on the biomolecule; (2) the biomolecule is aligned with the substrate such that the at least two nanoparticles are ordered on

the substrate in a non-random fashion; and (3) the biomolecule is covalently attached to the substrate.

Applicants respectfully submit that Dai does not teach the methods recited in claims 1 and 39, as currently amended. Dai teaches, for example, attaching aluminum and silicon chlorides to a long chain molecular polymer and dispersing metal oxide catalyst nanoparticles within the resultant alumina/silica matrix. Dai further teaches that the "long chain molecular polymer" can be a surfactant, such as a soap, or a polymer, such as a block copolymer (*See* Dai, column 4, lines 5-13), but is silent as to use of biomolecules in the disclosed methods. Thus, Dai does not teach attaching catalyst nanoparticles to a biomolecule, much less attaching the catalyst nanoparticles to a biomolecule with a defined spacing between the nanoparticles as recited in amended claims 1 and 39.

Additionally, Dai is silent as to (1) "aligning a biomolecule with a substrate such that the catalyst nanoparticles are ordered on the substrate in a non-random fashion," and (2) "covalently attaching the biomolecule to a substrate." The Dai methods involve, for example, dispersing metal oxide catalyst nanoparticles within an alumina/silica matrix and depositing this matrix on a substrate via dip coating, spin coating, patterning transferring or contact printing techniques (*See* Dai, column 4, lines 33-37). The Applicants submit that these techniques do not involve a biomolecular alignment step to order catalyst nanoparticles on a substrate or the *covalent* attachment of a biomolecule to a substrate, as are required in the currently amended claims. Instead, the Dai methods allow for the non-random ordering of catalyst nanoparticles because the nanoparticles are *non-covalently* applied to well-ordered conical tips disposed on a substrate (*See*, e.g., Dai Figs 2A-D and Fig 4B).

Based on the foregoing amendments and remarks, Applicants submit that Dai does not teach all of the limitations of claims 1 and 39 as currently amended, and therefore does not anticipate claims 1 and 39. Accordingly, the applicants request that the present rejection should be withdrawn. Applicants also request that the rejection to claims 5, 6, 8, 14, 18, 20, 21, and 40 should also be withdrawn because these claims depend from either claim 1 or claim 39 as currently amended.

Rejection of claims under 35 U.S.C. § 103(a)

The Examiner has maintained the substance of all obviousness rejections originally asserted in the Office Action of June 8, 2006, and further rejected claims 1-6, 8-9, 11, 14-21 and 39-41 as obvious over applicants own alleged admissions. The details of each rejection and applicants' response are addressed in detail below.

Claims 2-4 and 41 have been rejected as allegedly obvious over Dai in view of Herr (US 2004/0072994). The Examiner contends that, although Dai does not teach using a peptide, protein or nucleic acid, Herr discloses a method for producing nanotubes on a substrate with a catalyst attached to DNA, RNA or proteins. The Examiner asserts that it would be obvious to use these biomolecules in the methods of Dai because Herr teaches they are effective for attaching catalysts.

Claims 9 and 11 have been rejected as allegedly obvious over Dai. The Examiner contends that, although Dai teaches attaching the polymer to the nanoparticles before attaching it to the substrate, it would have allegedly been obvious to attach the nanoparticles at any point in the process. The examiner further asserts that Dai teaches a uniform distance between the nanotubes as required in claim 11.

Claims 15 and 16 have been rejected as allegedly obvious over Dai in view of Chan (US 6,696,022). The Examiner contends that, although Dai does not teach how to align polymer molecules, it would have allegedly been obvious to do so in view of the alignment methods of Chan (i.e., optical tweezers and/or molecular combing).

Claim 17 have been rejected as allegedly obvious over Dai in view of Bonard. The Examiner contends that, although Dai does not teach ferritin as a catalyst for nanotube formation, it would have allegedly been obvious to do so in view of Bonard's teaching that ferritin can be used to catalyze nanotube production.

Claim 19 have been rejected as allegedly obvious over Dai in view of Leiber (U.S. 6,159,742). The Examiner contends that, although Dai does not teach using biotin-streptavidin to attach the polymers to the nanotubes, it would have allegedly been obvious to do so in view of Leiber's teaching that biotin-streptavidin is useful for adhesion of nantoubes to polypeptides and nucleic acids.

The rejections are respectfully traversed.

To establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). "All words in a claim must be considered in judging the patentability of that claim against the prior art." *In re Wilson*, 424 F.2d 1382, 1385, 165 USPQ 494, 496 (CCPA 1970). If an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988).

With respect to the rejection over Dai in view of Herr (i.e., claims 2-4 and 41) applicants submit that neither of the references teach or suggest covalently attaching a biomolecule to a

substrate, as required by claim 1 as currently amended. Thus, the *prima facie* case as applied to claims 2-4 and 41 is inappropriate as these claims depend from claim 1 as currently amended. Accordingly, applicants request that the present rejection over Dai in view of Herr be withdrawn.

With respect to the rejection over Dai (i.e., claims 9 and 11), applicants submit that Dai does not teach or suggest using a biomolecule, attaching a catalyst nanoparticle to the biomolecule, aligning the biomolecule with a substrate, or covalently attaching the biomolecule to the substrate as required by claim 1, as currently amended. Thus, the *prima facie* case as applied to claims 9 and 11 is inappropriate as these claims depend from claim 1 as currently amended. Accordingly, applicants request that the present rejection over Dai be withdrawn.

With respect to the rejection over Dai in view of Chan (i.e., claims 15-16) applicants submit that neither of the references teach or suggest covalently attaching a biomolecule to a substrate, as required by claims 1 as currently amended. Thus, the *prima facie* case as applied to claims 15 and 16 is inappropriate as these claims depend from claim 1 as currently amended. Accordingly, applicants request that the present rejection over Dai in view of Chan be withdrawn.

With respect to the rejection over Dai in view of Bonard (i.e., claim 17) applicants submit that neither of the references teach or suggest using a biomolecule, attaching a catalyst nanoparticle to the biomolecule, aligning the biomolecule with a substrate, or covalently attaching the biomolecule to the substrate as required by claim 1, as currently amended. Bonard teaches the use of ferritin (i.e., a biomolecule) as a catalyst nanoparticle, but is silent as to the covalent attachment of this catalyst molecule to a biomolecule. Thus, the *prima facie* case as applied to claim 17 is inappropriate as this claim depends from claim 1 as currently amended.

Accordingly, applicants request that the present rejection over Dai in view of Bonard be withdrawn.

With respect to the rejection over Dai in view of Leiber (i.e., claim 19) applicants submit that neither of the references teach or suggest using a biomolecule, attaching a catalyst nanoparticle to the biomolecule, aligning the biomolecule with a substrate, or covalently attaching the biomolecule to the substrate as required by claim 1, as currently amended. Thus, the *prima facie* case as applied to claim 19 is inappropriate as this claims depends from claim 1 as currently amended.

Furthermore, applicants assert that Leiber teaches that biotin-streptavidin can adhere to a carbon nanotube, whereas claim 19 recites using biotin-streptavidin to bind a biomolecule to a catalyst nanoparticle. Thus, Leiber clearly teaches biotin-streptavidin for an entirely different intended purpose that the purpose it serves in the claimed invention. Accordingly, a combination of Dai and Leiber would not lead to the invention of claim 19, at least because Leiber does not teach or suggest biotin-streptavidin for binding a biomolecule and a catalyst nanoparticle. Based on the above remarks, applicants request that the present rejection over Dai in view of Leiber be withdrawn.

With respect to the rejections to claims 1-6, 8-9, 11, 14-21 and 39-41 over the applicants own alleged admissions in the present specification, the applicants respectfully remind the Examiner that, when applying 35 U.S.C. 103, the following tenets of patent law must be adhered to:

"(A) The claimed invention must be considered as a whole;

> (B) The references must be considered as a whole and must suggest the desirability and thus the obviousness of making the combination;
>
> (C) The references must be viewed without the benefit of impermissible hindsight vision afforded by the claimed invention; and
>
> (D) Reasonable expectation of success is the standard with which obviousness is determined." (*See* MPEP 2141(II); emphasis added).

In the present rejection, the Examiner has done no more than list twenty-four excerpts from the specification which describe prior art techniques that may be employed in the practice of the presently claimed invention. The Examiner has not, however, provided any argument as to why the any of the references cited within these excerpts provide a suggestion or motivation to combine their teachings to arrive at the presently claimed invention. Applicants also assert that the Examiner has used hindsight reconstruction afforded by the present specification and claimed invention to arrive at his rejection. Finally, the Examiner has provided no evidence as to why a combination of the references would provide a reasonable expectation that the present invention would succeed. The Examiner bears the burden of factually supporting any *prima facie* conclusion of obviousness. Based on the above remarks, the applicants' submit that the Examiner's initial burden has not been met and the obviousness rejection is therefore improper. Withdrawal of the rejection is requested accordingly.

CONCLUSION

Each and every point raised in the Office Action dated May 17, 2007 has been addressed on the basis of the above amendments and remarks. In view of the foregoing it is believed that all pending claims are in condition for allowance and it is respectfully requested that the application be reconsidered and that all pending claims be allowed and the case passed to issue.

If there are any other issues remaining which the Examiner believes could be resolved through a Supplemental Response or an Examiner's Amendment, the Examiner is respectfully requested to contact the undersigned at the telephone number indicated below.

Dated: October 17, 2007

Respectfully submitted,

By _____

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